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Old Babylonian Systems of Weights and Measures.—By George A. Reisner, Harvard University.

In January of last year, the Royal Museum in Berlin received about 500 clay tablets, presented by Mr. James Simon. In editing these tablets which proved to be account-books of the temples at Telloh from the time of the 2nd dynasty of Ur, a number of new points concerning the old Babylonian systems of weights and measures came to light, and were published by myself in the "Sitzungsberichte" of the Berlin Academy Vol. XIX, p. 417 ff. (April 9, 1896). The conclusions arrived at in that article (which has never appeared in English) and the facts upon which they were based, form the body of the present article.

I. Measures of Area.

1 GAN ( ) = 1800 ŠAR. 1 ŠAR () = 60 GIN.

1 GIN ( ) = 180(?) ŠE ().[1]

1 ŠAR = 1 sq. GAR-DU (Thureau-Dangin).[2]

The proof that 1 ŠAR = 60 GIN, is furnished, for example, by VA. Th. 22 13

1. Appears by analogy (see system of weights).
2. See Revue d'Assyriologie, Vol. IV, No. 1, 1897, pp. 13-27.

which reads as follows:

Obv: l. 1: [illegible] ŠAR [illegible] GIN, harvest of ŠAM ISI (a plant) of that amount (ŠA-BI-TA),

3: [illegible] ŠAR, temple of Nin-girsu,
[illegible] ŠAR, temple of Ningiszidda.

5: Total: [illegible] ŠAR harvested (KIN-AG).
Remainder: [illegible] ŠAR [illegible] GIN, not harvested.

Subtracting from the amount given in l. 1, the amount given in l. 5, we obtain as result 1187½ ŠAR 2½ GIN − 216½ ŠAR = 971⅙ ŠAR 2½ GIN. Comparing this result with remainder given in l. 6 of the tablet, we get the equation ⅙ ŠAR = 10 GIN. Therefore, 1 ŠAR = 60 GIN. Two other examples, taken from the same tablet, yield the same result.

The equation, 1 GAN = 1800 ŠAR, is proved conclusively by a number of items given on YA. Th. 2210. For example l. 19 of Col. VII reads: "5 GUD-APIN 120 ŠAR-TA A-ŠAG ⅓ (▷◁) GAN," - i.e. "5 ploughoxen at 120 ŠAR apiece[1] (are sufficient for) a field of ⅓ GAN." Therefore 5 x 120 ŠAR, or 600 ŠAR, = ⅓ GAN, and 1 GAN = 1800 ŠAR. In addition to a score or more of similar items, this equation is supported by the fact that on tablet YA. Th. 2212, we find the sums 402½ ŠAR and 1122½ ŠAR, and on tablet YA. Th. 2213 we find the sum 1426⅚ ŠAR. Such figures are conceivable only when 1 GAN exceeds

1. Apparently it means that each ox ploughed 120 ŠAR of land a day.

1426 ŠAR,— a fact which agrees entirely with the equation established above.

Besides this system of measures of area, the new tablets use a peculiar notation of the GAN, as follows:

= $\frac{1}{72}$ (BUR) GAN.	= 1 (BUR) GAN (= 1800 ŠAR).
" = $\frac{1}{36}$ " " .	" = 10 " " .
" = $\frac{1}{18}$ " " .	" = 60 " " .
" = $\frac{1}{3}$ " " .	" = 600 " " , etc.

The proof of these conclusions is to be found in a number of calculations from different tablets. VA.Th.2301 gives a list of fields and the amounts of grain used in sowing them. L. 2 of Rev. Col. II, gives the sum of the fields which required $1\frac{4}{5}$ GUR of grain pro GAN, as (A) . The single entries of such fields are as follows:

Obv. I, 9:				.
" II, 3:				" .
" II, 7:				" .
" II, 11:				" .
" II, 15:				" .
" III, 1:				" .

The addition of these entries gives us the sum (B) . Now, according to the notation set forth above, 6 are equal to 2 , 20 are equal to 2 ; and thus, sum (B) is reduced to (32 GAN) or sum A,— the sum given on the tablet.

Rev. II, 5 of the same tablet, gives us the sum of the fields that required $1\frac{1}{2}$ GUR of grain pro GAN, (A) [illegible].
The single entries are:

Obv. I, 1: [illegible].
" I, 8: [illegible] .
" I, 13: [illegible] .
" II, 2: [illegible] .
" II, 7: [illegible] .
" II, 15: [illegible] .

The addition of these entries gives us the total (B) 7 [illegible], 14 [illegible], 4 [illegible], 3 [illegible] GAN. According to the proposed notation, 4 [illegible] are equal to [illegible] + [illegible], 14 [illegible] are equal [illegible] + [illegible] and 7 [illegible] are equal to [illegible] + [illegible]. Thus sum B is reduced to [illegible], or sum A.

On VA.Th.2202, the sum of the amounts of seed-grain used for three fields is given as $168\frac{3}{20}$ GUR (Rev. Col. III). Leaving the [illegible] which occurs in the second field, out of the calculation, and using the notation given above, we get:

$58\frac{1}{6}$ ([illegible]) GAN at	$1\frac{1}{2}$	GUR	pro	GAN	[makes	$81\frac{5}{20}$	GUR]
$39\frac{1}{4}$ ([illegible]) "	"	$1\frac{1}{5}$	"	"	"	["	$71\frac{4}{20}$	"]
8 ([illegible]) "	"	$1\frac{1}{5}$	"	"	"	["	$9\frac{12}{20}$	"]
						[Total:	$168\frac{1}{20}$	"]

Thus we obtain $168\frac{1}{20}$ GUR instead of $168\frac{2}{20}$ GUR, the total given on the tablet. The difference is, of course, due to the omission of ◁ ▽ (at $1\frac{4}{5}$ GUR) in the second field. Therefore, ◁ GAN : 1 GAN :: $\frac{1}{20}$: $1\frac{4}{5}$, and ◁ GAN = $\frac{5}{180}$ GAN = $\frac{1}{36}$ GAN. Another paragraph of the same tablet gives the amount of seed used for three other fields as 641 GUR 225 ḲA. Leaving ▽ GAN in the second field out of the problem, we obtain by the calculation of the single entries $641\frac{5}{6}$ GUR, or 641 GUR 250 ḲA, as the total amount of seed. The difference between our sum and that on the tablet, 5 ḲA, is due to the omission of ▽ GAN in the second field (at $1\frac{1}{5}$ GUR, or 360 ḲA). Therefore, ▽ GAN : ◁ GAN :: 5 : 360. ▽ GAN = $\frac{5}{360}$ GAN = $\frac{1}{72}$ GAN.

It is also to be noted that neither on the Berlin tablets nor on any of the tablets already published, can more than one ▽ GAN be found, more than one ◁ GAN, more than five ▷— GAN, more than two ▷◁, more than nine ◁ GAN, more than five ⋈ GAN, or more than nine ☆ GAN. The view put forth by Meissner ("Beiträge zum altbabylonischen Privatrecht", p. 126) that ◁ GAN = 10 GAN, ▷◁ GAN = 5 GAN, and ▷— GAN = 1 GAN is proved incorrect by the single fact that ⋈ GAN occur repeatedly. VA. Th. 468, published by Meissner himself, gives ◁ GAN as the sum of ⋈ GAN and ▷◁ GAN.

Thus the relations of the values of the various notation-signs to each other present the scale: $\frac{1}{72}$ (𒁹), $\frac{1}{36}$ (𒁹𒁹), $\frac{1}{18}$ (𒁹𒁹𒁹), $\frac{1}{3}$ (𒁹𒁹𒁹𒁹𒁹), 1 (𒁹), 10 (𒌋), 60 (𒌋𒁹), 600 (𒌋𒌋), etc. It now remains to be shown that 𒁹 GAN is really unity. (1.) In the first place, the problems presented by the tablets can be correctly solved only when we treat 𒁹 GAN as unity. In the examples given above, in which the amount of seed-grain used is recorded, we get a total eighteen times too large (i.e. larger than the total on the tablet) if we use 𒁹𒁹𒁹 GAN as unity.[1] (2.) By taking 𒁹 GAN as unity we obtain, aside from the fractions, the normal old Babylonian scale, the scale which every other system of notation shows at this time, — unity, ner of unity, sos of unity, ner of sos, sar of unity, ner of sar,[2] etc. As for the fractions, the other notation-systems offer no analogies (except for $\frac{1}{3}$). It is to be noted however that if we take 𒁹𒁹𒁹 GAN as the unit, we get a fraction, $\frac{1}{4}$ (𒁹), for which, though expressed repeatedly by 𒁹𒁹𒁹𒁹𒁹𒁹𒁹𒁹𒁹𒁹𒁹𒁹, there was no separate sign in the other systems. (3.) We find repeatedly in

1. Proposed by Meissner, "Beiträge zum altbabylonischen Privatrecht" p. 126. Adopted by Oppert, "Comptes rendus de l'académie des inscriptions et belles-lettres" (April 3, '96). See also Oppert's paper, "Comptes rendus" (Dec., 1896), and Eisenlohr's pamphlet "Ein altbabylonischer Feldersplan" (Leipzig, 1896). The foundation of Oppert's theory was destroyed by Thureau-Dangin's article in the "Revue d'assyriologie" (IV, pp. 13–27).

2. First set forth by Lehmann; see MPA p. 98 where the pamphlets on this subject are named.

the tablets sums of 100 ŠAR, 180 ŠAR, 200 ŠAR, and even as high as 1426 ŠAR (see above). These would be out of the question, if ▷ GAN (= 100 ŠAR) were unity. But since ◁ (= 1800 ŠAR) is unity, these sums are to be expected, expressed either in ŠAR or in fractions of the next higher unit.

II. System of Weights.

1 Talent (▷) = 60 Minas. 1 Mina (▷) = 60 Shekel.

1 Shekel ( ) = 180 ŠE ( ).

It is unnecessary to reproduce the proofs for the first two equations as they have been generally assumed as true for old Babylonian times. As for the third equation, Meissner (MBP, p. 94) has shown that 1 shekel contained more than 40 ŠE; and Peiser (KB, Vol. IV¹ p. 40) states, without giving his reasons, that 1 shekel may have contained either 120 or 180 ŠE. Two large tablets in the Berlin collection, VA. Th. 2243 and 2244, give the values of different objects and materials in silver. VA. Th. 2243, XIII ll. 18–21 reads:

"87 (pieces) of GUG(?)-DUMU wood at 60 (pieces for one shekel) makes[1] 1½ shekel 21 ŠE of silver." 87 pieces of wood at 60 for a shekel makes $\frac{87}{60}$ shekel. $\frac{87}{60} = 1\frac{27}{60} = 1\frac{1}{2} + \frac{7}{60}$. Thus the 21 ŠE of the tablet must equal $\frac{7}{60}$

1. Lit. "its silver (AZAG-BI) is 1½ shekel 21 ŠE."

shekel; and 1 shekel = $\frac{60 \times 21}{7}$ ŠE = 180 ŠE. All similar examples lead to the same result.

In the notation of the weights, there is little that is unusual. The fact that units of the GUN, or talent, are written with the horizontal wedge, while the units of the other weights are written with the vertical wedge, has been indicated above. The following fraction-signs are, however, of interest: [illegible] = $\frac{2}{3}$ shekel; [illegible] (or [illegible]) [illegible] = $\frac{1}{3}$ (or $\frac{2}{3}$) mina. These are used, at least when silver is the material weighed, even without the signs for mina or shekel (cf. the similar use of [illegible] X [illegible] in this and in later times).

III. Measures of Capacity.

1 Karu ([illegible]) = 3600 GUR (also written [illegible]).

1 GUR ([illegible]) = 5[PI?] = 300 ḲA. 1 ḲA ([illegible]) = 60 GIN ([illegible])

The system of measures of capacity is the same as that first proposed by Lehmann (ZA. IV p. 290)[1] on the basis of VA. Th. 2596; and, with the exception of the double notation for 3600 GUR, the notation is the same. The equation, 1 ḲA = 60 GIN, appears from a number of tablets; for example, VA. Th. 2336 Obv. 3: [illegible] 4 [illegible], "106 vessels of .... oil at 4 GIN

1 See also Oppert, ZA. IV 371 and I 87, and Meissner, MBP p. 98.

(apiece) make 7 KA 4 GIN of oil" (lit. "its oil is" etc.). Now, 106 × 4 GIN = 424 GIN. Thus, 424 GIN − 4 GIN = 7 KA. 1 KA = $\frac{420}{7}$ GIN = 60 GIN.

IV. Ordinary Notation.

1 = 𒁹 or 𒁹. 10 = 𒌋. 60 = 𒁹. 600 = 𒁹 (10 × 60). 3600 = 𒁹. 36,000 = 𒁹 (10 × 3600). 72,000 = 𒁹 (20 × 3600). 108,000 = 𒁹 (30 × 3600). Etc. 216,000 = 𒁹 (60 × 3600).

One of the peculiarities of the ordinary notation is the method of writing 9 (and even 7 and 8), namely, 𒌋𒁹𒁹[1] (10 LAL 1) "10 less 1", or, rather, "10 there remains one". The character of this expression is well shown by such cases as 𒌋𒁹𒁹 𒁹𒁹𒁹, "20 less 2 gur", 𒌋𒁹𒁹 𒁹𒁹𒁹 "20 gur less 180 ka", and 𒌋𒁹𒁹 𒁹𒁹𒁹 𒁹𒁹𒁹 𒁹𒁹𒁹 (VA.Th.2244 V 12) "$\frac{1}{4}$ shekel less 5 ŠE". LAL is also used ordinarily to mark the remainder. This 𒌋𒁹𒁹 explains the later 𒁹, the abbreviation of 𒁹. 𒁹 is merely a cursive corruption of 𒌋𒁹𒁹. In the more carelessly written of the Berlin tablets, 𒌋𒁹𒁹 already appears as 𒌋𒁹𒁹.

1. After I had finished the article which appeared in the Journal of the Berlin Academy, Dr. Lehmann called my attention to Jensen's "Kosmologie", p. 106, note 2, where Jensen has very correctly taken 𒌋𒁹𒁹 to mean "undersigned". 𒌋𒁹𒁹 is probably a mistake (of the Assyrian scribes) for 𒌋𒁹𒁹. See also Oppert, ZA. X.